

Publication number : 2002-341362

Date of publication of application : 27.11.2002

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Int.Cl. G02F 1/1341 G02F 1/13

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Application number : 2001-149779

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Date of filing : 18.05.2001

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A METHOD OF PRODUCING A LIQUID CRYSTAL DISPLAY PANEL AND AN  
APPARATUS FOR PRODUCING A LIQUID CRYSTAL DISPLAY PANEL

15 [Abstract]

PROBLEM TO BE SOLVED: To provide a method of manufacturing a liquid crystal display panel which is capable of realizing the liquid crystal display panel of a high display grade and high yield without precise equipment adjustment and an apparatus for manufacturing the same.

20 SOLUTION: The method of manufacturing the liquid crystal display panel by dropping liquid crystals onto a glass substrate by a microsyringe and the apparatus for manufacturing the same, in which the dropping of the liquid crystals onto the glass substrate by the microsyringe is performed by blowing air to the tip of the

microsyringe after the heating of the liquid crystal in order to lower the viscosity of the material of the liquid crystal.

**[Claim(s)]**

**[Claim 1]** A method of producing a liquid crystal display panel that has liquid crystal dropped on a glass substrate using a micro syringe, comprising:

5 a process of heating said liquid crystal in order to reduce a viscosity of said liquid crystal; and  
a process of dropping said liquid crystal on said glass substrate.

**[Claim 2]** The method of producing a liquid crystal display panel of claim 1, wherein said process of dropping said liquid crystal on said glass substrate consists of a process of blowing an air into a tip of said micro syringe.

10 **[Claim 3]** An apparatus for producing a liquid crystal display panel in which liquid crystal is dropped on a glass substrate by micro syringe, wherein the apparatus comprising a heating means for heating said liquid crystal in order to reduce a viscosity of said liquid crystal.

**[Claim 4]** The apparatus for producing a liquid crystal display panel of claim 3, 15 wherein the apparatus further comprises an air nozzle for blowing an air into a tip of said micro syringe so that said liquid crystal is dropped on said glass substrate by blowing the air into the tip of said micro syringe.

**[Title of the Invention]**

A METHOD OF PRODUCING A LIQUID CRYSTAL DISPLAY PANEL AND AN  
APPARATUS FOR PRODUCING A LIQUID CRYSTAL DISPLAY PANEL

**[Detailed Description of the Invention]**

5   **[Field of the Invention]**

This invention relates to a method and apparatus for producing a liquid crystal display panel by dropping liquid crystals on a glass substrate by micro syringe.

**[Description of the Prior Art]**

10           Conventionally, in a method of producing a liquid crystal display panel, there are a drop method of a liquid crystal that produces the liquid crystal display panel by dropping the liquid crystal on the glass substrate before attaching the glass substrate; and a injection method of a liquid crystal that produces the liquid crystal panel by injecting the liquid crystal on the glass substrate which has been attached.

15           In the case of producing the liquid crystal panel which is more than middle size, there is used the drop method of liquid crystal that has lower number of processes.

Fig. 3 illustrates the method of producing the liquid crystal panel according

to the prior art drop method of a liquid crystal. With respect to Fig. 3, reference numerals 301, 302 indicate the glass substrate with transparent electrode that is processed to align a liquid crystal, 303 indicates the liquid crystal, 304 is a sealing resin, and 305 is a micro syringe.

5        The sealing resin for the use of joining glass substrates and sealing the liquid crystals is printed on the glass substrate 302 that is one glass substrate of two glass substrates 301, 302, whereas the liquid crystal 303 is dropped using the micro syringe 305 on the glass substrate 301 that is the other glass substrate. The drop method is performed by pushing a liquid crystal from the tip of the micro  
10      syringe and attaching that liquid crystal on the glass substrate 301.

And, the liquid crystal panel is completed by joining two glass substrates 301, 302.

**[Problem(s) to be Solved by the Invention]**

However, the liquid crystal 303 that is dropped on the glass substrate 301 is  
15      normal temperature of 25°C, and typically high viscosity of 20mPa·s. Due to these facts, the amounts of drop per one point are at least 1mg, such that the distance between the drop points needs to be 10mm.

Consequently, the liquid crystal display panel that is produced by joining the glass substrate 301 on which the liquid crystal 303 is attached at a wide distance between drop points and the glass substrate 302 in which sealing resin is printed, is likely to induce the difference of threshold voltage of the liquid crystal 303 due to 5 the drop portions and the distance portions therebetween, which results in preventing the display uniformity of liquid crystal panel.

And, upon dropping the liquid crystal 303 by means of micro syringe, the tip of the micro syringe must accurately be adjusted at a distance of 0.2mm from the glass substrate and to be set uniformly, in order to attach the liquid crystal 303 in 10 the tip of the micro syringe 305 on the glass substrate 301, therefore it needs to be adjusted accurately in order to lower the amounts of drop in one point. If it is not adjusted enough accurately, the tip of the micro syringe is contacted to the glass substrate, so that display deterioration of liquid crystal display panel results in.

The object of this invention is to prevent the above-described problems and 15 to provide a method and apparatus for producing a liquid crystal display panel that can provide the liquid crystal panel of good display uniformity and good yield without a need to adjust a facility accurately.

[Means for Solving the Problem]

The resolve the above problems, a method of producing a liquid crystal display panel that drops a liquid crystal on a glass substrate by micro syringe comprises: a process of heating the liquid crystal in order to reduce a viscosity of the liquid crystal; and a process of dropping the liquid crystal on the glass substrate.

Further, in the method of producing a liquid crystal display panel, the process of dropping the liquid crystal on the glass substrate consists of a process of blowing an air into a tip of the micro syringe.

Further, an apparatus for producing a liquid crystal display panel that drop a liquid crystal on a glass substrate by micro syringe comprises a heating means for heating the liquid crystal in order to reduce a viscosity of the liquid crystal.

Further, in the apparatus for producing a liquid crystal display panel, the apparatus further comprises an air nozzle for blowing an air into a tip of the micro syringe so that the liquid crystal is dropped on the glass substrate by blowing an air into the tip of the micro syringe.

#### [Embodiment of the Invention]

##### (Embodiment 1)

A method and apparatus for producing a liquid crystal display panel according to embodiment 1 of this invention is described now with reference to

Fig.1. Fig. 1 illustrates the method of producing a liquid crystal display according to embodiment 1 of this invention. With reference to Fig. 1, reference numerals 101, 102 are glass substrates with transparent electrode that are processed to align the liquid crystal, 103 is a liquid crystal, 104 is an sealing resin, 105 is a micro syringe, 5 and 106 is a heater for heating the liquid crystal.

The sealing resin for the use of joining glass substrates and sealing the liquid crystals is printed on the glass substrate 102 that is one glass substrate of two glass substrates 101, 102, whereas the liquid crystal 103 is dropped using the micro syringe 105 on the glass substrate 101 that is the other glass substrate.

10 Then, the liquid crystal 103 is heated at 70°C by means of heater 106 so that a viscosity of the liquid crystal 103 is 10mPa·s.

Therefore, the amounts of drop of liquid crystal by micro syringe 105 can be reduced down to at least 0.2mg, and the distance of the dropping points can be a narrow pitch of at least 3mm. The liquid crystal panel is produced by joining the 15 glass substrate 102 to that glass substrate 101 on which the liquid crystal 103 is attached.

As such, in view of the drop method of liquid crystal by micro syringe 105, since it reduces a viscosity of the liquid crystal by heating the liquid crystals that are dropped, it makes the distance between drop points narrow and reduces the

difference of threshold voltage of liquid crystals that is caused by the drop portions and the distance portions therebetween, which leads to an improvement of yield.

Even though it is described about the case of heating the liquid crystals at 750°C by heater 106 in embodiment 1 of this invention, the temperature of the 5 liquid crystals heated may be enough if it is a temperature that can reduce the viscosity of the liquid crystal, and may be optimized at the temperature less than a phase transition temperature of liquid crystal.

(Embodiment 2)

A method and apparatus for producing a liquid crystal display panel 10 according to embodiment 2 of this invention is described below with reference to Fig. 2. Fig. 2 illustrates the method of producing a liquid crystal display according to embodiment 2 of this invention. Further, the method and apparatus for producing the liquid crystal display panel according to embodiment 2 of this invention is characteristic of dropping the liquid crystal, and it is in common with above 15 embodiment 1 that they heat the liquid crystal to reduce the viscosity of it. Therefore, like elements as in the method and apparatus for producing liquid crystal panel according to embodiment 1 are denoted as like numerals, and descriptions thereof are omitted.

With respect to the Fig. 2, reference numerals 101 is glass substrates with

transparent electrode that is processed to align the liquid crystal, 103 is a liquid crystal, 104 is an sealing resin, 105 is a micro syringe, and 106 is a heater for heating the liquid crystal, 201 is an air nozzle that is put aside micro syringe 105, and 202 is an air blown into the tip of the micro syringe 105.

5 As described in Fig. 3, the liquid crystals 103 is dropped on the glass substrate 101 from the micro syringe 105 by blowing an air from an air nozzle 201 into the tip of the micro syringe 105.

As such, it is possible to make the distance between the micro syringe 105 and the glass substrate 101 1mm by dropping the liquid crystal 103 on the glass substrate while blowing an air into the tip of the micro syringe 105, and even if it reduce the amounts of drop in one point, it is possible to produce the liquid crystal of high quality without a need to adjust the locations of the micro syringe and the glass substrate accurately.

#### [Effect of the Invention]

15 According to the method and apparatus for producing the liquid crystal display panel as above-described, when dropping the liquid crystal on the glass substrate using the micro syringe, since this invention heats the liquid crystal near a phase transition temperature to reduce a viscosity of it, the invention can reduce minimum amounts of drop possibly by the micro syringe and increase the number

of drop points, which results in decreasing the difference of threshold voltage of the liquid crystal panel between the drop portions and the distance portions therebetween.

Further, according to a method and apparatus for producing liquid crystal panel of this invention, when dropping the liquid crystal on glass substrate using micro syringe, since this invention heats the liquid crystal near a phase transition temperature at the same time with blowing an air from an air nozzle put aside the micro syringe on the glass substrate to reduce a viscosity of the liquid crystal, and drops that liquid crystal, the invention can realize the liquid crystal panel of high quality display and high yield without a need to adjust a facility accurately.

**[Description of Drawings]**

Fig. 1 illustrates a method of producing the liquid crystal panel according to embodiment 1 of this invention.

Fig. 2 illustrates a method of producing the liquid crystal panel according to 5 embodiment 2 of this invention.

Fig. 3 illustrates a method of producing the liquid crystal panel according to prior art.